

Structural Vulnerability Assessment Methodology

Problem: Critical Highway Assets are Vulnerable to Attack

Subsequent to the terrorist attack of September 11th, 2001, bridge and highway engineers faced new and largely unexpected challenges related to protecting the physical security of critical transportation assets against possible attacks. Though the 9/11 events targeted buildings of significance, Al Qaida has also identified bridges and tunnels as potential targets. All bridge and highway owners were asked to assess the vulnerability of their structures and to identify means for reducing this vulnerability. With guidance provided by the American Association of State Highway and Transportation Officials (AASHTO) Transportation Security Task Force, many States had identified structures that could be “high risk” targets for terrorism involving use of weapons of mass destruction (WMD). In many circumstances, however, States do not have the traditional expertise to develop standards and ways to reduce WMD impacts on structures. Highway agencies must identify the “missing” gaps and seek “best practices” guides and innovative techniques to enhance the security of their critical assets.

Putting it in Perspective

- Bridges and tunnels are potentially attractive targets for terrorists because many serve as infrastructure choke points.
- U.S. has about 600,000 bridges and 600 tunnels, of which 500 have been classified as critical facilities based on size, traffic volume, and strategic importance.
- Bridges and tunnels are extremely vulnerable because of its openness and accessibility to the public.
- Attacks on critical assets could create thousands of casualties, widespread fear and economic disruption.

Solution: Provide specified levels of reliability when subjected to manmade attacks with mitigation measures based on results of structural vulnerability assessment.

What is structural vulnerability assessment?

Structural vulnerability assessment is a system approach to identify vulnerable element(s) of a bridge or tunnel when subjected to explosive terrorist threats. The methodology is found on engineering principles and state-of-art knowledge base gained from Army Corp of Engineers (COE) in explosive uses and bridge demolition. With good understanding of blast effects on structures, asset owners could then develop cost-effective strategies to mitigate or minimize the consequences of an attack through deterrence/detection/prevention.

What are the advantages to infrastructure owners?

While working with budget constraints, many infrastructure owners pondered the risks of critical assets in their inventory being targeted by terrorists but left with uncertainties to find effective ways of protection. A successful structural vulnerability assessment will provide owners decision-making tools to implement mitigation measures and set budget priorities for short and long term improvements. During heightened security alert, operation expenses will be less costly but effective by focusing surveillance efforts only on vulnerable areas of the structure identified through the assessment process.

How is this new methodology being disseminated?

Dissemination of assessment methodology can be done in following formats:

- Engineering assessment team assembled by FHWA to provide technical advice and field review directly to the State or local agencies.

- Offer extensive three days workshop on “Bridge and Tunnel Vulnerability” to Federal and State personnel at the COE training center in Vicksburg, MS.
- Conduct one day briefing on structural vulnerability assessment to State and local agencies at any location.

Successful Applications: States’ Results Demonstrate Success

Many States have received technical assistance and knowledge through one or more of above formats:

Engineering Assessment Team

FHWA assessment teams have conducted on-site plan and field reviews on critical structures identified by the Department of Transportation (DOT) for States of Minnesota, Washington and Wisconsin. A full report documenting structural vulnerabilities for each structure, recommendations for mitigations and countermeasures will be provided to DOT for actual implementation.

Bridge and Tunnel Vulnerability Workshop

Four workshops had been conducted since 2003 to introduce engineers to the state-of-the-art for structural vulnerability assessment and blast analysis including explosive phenomenology, dynamic structural response, engineering standards, calculation tools/procedures and mitigation strategies. Participants also gained a thorough understanding of terrorist threats and tactics, effects of explosives on structures while witnessing a real explosive detonation on a scale bridge model. Trainees thus far consisted of: 28 State DOT engineers, 43 FHWA engineers, 1 USACE engineer, 34 consultants, and 3 engineers from private toll authorities. Due to its success and favorable reviews, AASHTO Technical Committee for Security (T-1) has recommended continued enhancement and presentation of these workshops.

One Day Briefing to Wisconsin

A 1-day condensed version of the Bridge and Tunnel Vulnerability Workshop was presented to over 50 personnel from the Wisconsin DOT including engineers, bridge inspectors, and maintenance personnel. Unlike the 3-day Workshop that is geared to engineers, this one-day briefing is geared to those persons that will be on the “front lines” of a terrorist event involving bridges or tunnels. It is designed to give emergency responders an understanding of bridge/tunnel structures in general, their strengths and weaknesses, and the damage to be expected for terrorist explosive attacks. It will provide bridge inspectors an understanding of the most likely spots for explosive placement in order to make their searches as efficient as possible. The Workshop received very favorable reviews and as a result, two other states, Minnesota and Washington State, are in the process of planning similar Workshops for their personnel.

Benefits:

- Knowledge transfer to State and local agencies on structural vulnerability assessment methodology
- Develop a resilient physical infrastructure that can withstand acts of terrorism
- Develop better decision support tools for implementation of effective mitigation strategies
- Establish a network of sharing best practices and innovative techniques for protection and prevention.
- Reassure the public for safe and reliable operation of bridges and tunnels

Additional Resources:

To learn more, visit:

www.fhwa.dot.gov/resourcecenter/index.htm

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